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FOLIAR SPRAYING OF SPROUTING TANOAK PLANTS BEST IN LATE SUMMER

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U.S.D.A. Forest Service
Research Note PSW-207
1970

ABSTRACT: Three methods of applying two herbicides on individual plants of sprouting tanoak were tested at monthly intervals from May to September on the Six Rivers National Forest, California. Foliar sprays–by either backpump sprayer or backpump mistblower–gave best control from September and August applications. The two herbicides tested–2,4,5-T alone or a 1:1 mix with 2,4-D–were equally effective. The most effective treatments produced 50 to 75 percent average kill of crown clumps and 70 to 90 percent reduction of crowns that were present two years earlier.

OXFORD: 414.22–0874:176.1 *Lithocarpus densiflorus* + 174.2 *Pseudotsuga menziesii:*243.8.
RETRIEVAL TERMS: Lithocarpus densiflorus; herbicide applications; plant control; 2,4-D; 2,4,5-T; *Pseudotsuga menziesii;* release.

After logging and slash burning, tanoak *(Lithocarpus densiflorus* [Hook. and Arn.] Rehd.*)* in the northern California Coast Ranges grows vigorously as new sprouts. Often reaching heights of 13 feet in 5 years,[1] the sprouts compete seriously with the slower growing seedlings of Douglas-fir *(Pseudotsuga menziesii* [Mirb.] Franco var. *menziesii).* A reliable, economical method is needed for releasing the seedlings from tanoak suppression.

From herbicide trials aimed at controlling tanoak by spraying individual plants, we found that foliar applications in September and August gave better control than earlier foliar spraying. For all dates combined, 2,4,5-T alone or a 1:1 mix with 2,4-D were equally effective.

METHODS

The study area–located in the Lower Trinity District, Six Rivers National Forest in northern California–was a patch cut logged by tractors in fall 1960, with the slash burned a year later. The area has a northeast exposure, and lies at 3,000 feet elevation. Terrain is relatively gentle benches, with slope gradients of 6 to 40 percent.

The tanoak sprouts were in their third growing season when the study was started in 1964. The clumps were 1 to 5 feet tall. The stand was irregular, ranging from 7 to 39 sprouting clumps in the individual 0.1-acre plots.

We tested three methods of applying two herbicides at five different dates for a total of 30 treatments at random in each of three blocks. Each treatment was applied on three plots having a total of 30 to 77 clumps per treatment.

The three application methods were:

1. *Backpack mistblower foliar spray* of each entire clump from all sides until all leaves appeared to be moist. The blower was calibrated to discharge 0.25 gallon per minute.

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2. *Backpump foliar spray* of each entire clump until the leaves appeared wet. Most stems also were sprayed. The nozzle on a short wand produced a fan-shaped spray.

3. *Backpump basal stem-leaf spray* of the lower 18 inches of each clump until stems and leaves were saturated to the run-off point. Thus, all foliage was sprayed on plants under 18 inches tall.

The two herbicides were: 2,4,5-T (2,4,5–trichlorophenoxy acetic acid); and a 1:1 mixture of 2,4,5-T and 2,4-D (2,4–dichlorophenoxy acetic acid). Both were butoxy ethanol esters formulated at 4 pounds acid equivalent (a.e.) per gallon. For 1 gallon of commercial formulation the carriers were: 1/2 gallon of diesel oil and 8-1/2 gallons water with the mistblower; 1 gallon diesel oil and 98 gallons water with the backpump foliar spray; and 24 gallons diesel oil with the basal spray.

Concentration of herbicide in the spray mixture differed between application methods: 4 pounds, a.e., per 10 gallons volume with the mistblower; 4 pounds, a.e., per 100 gallons with the backpump foliar spray; and 4 pounds, a.e., per 25 gallons with the backpump basal spray. This confounding of application method and herbicide concentration is an intrinsic feature of individual-plant spray tests.

The five spray dates were: May 19-20; June 23; July 23; August 20; and September 20, 1964. These monthly intervals were selected to span the typical dry season from the end of one rainy season to the beginning of the next. The air temperature in May favors rapid growth of tanoak sprouts, the summer months are hot, and temperatures are lower in the autumn. Sprout growth rate gradually subsides between early summer and autumn. The test period covered the time when weather and accessibility of the area could be depended on for efficient spray operations. It may exclude an earlier or later period when tanoak sprouts may be more susceptible, but when spraying is not so feasible.

The treatments were evaluated in June 1966, about 2 years after spraying. The current diameter was measured on each living sprout clump, which consisted mainly of new sprouts that had grown since spraying. The original diameter of each clump was estimated from observing the spread of the branches that had been killed by the spray. The original height could not be determined because of stem deterioration. All clumps with no resprouting were tallied as dead and their original diameters were estimated.

The square feet of crown surface in 1964 and the square feet of living crown in 1966 were calculated for each plot. From these two figures the reduction in crown cover was determined for each plot as a percentage of the 1964 crown area. This approach ignores growth that would have occurred if the plots had not been sprayed; instead, it gives relative figures for comparing plot treatments, but underestimates the full benefits of the spraying. The percent of plants killed in each plot was determined from the tally of all plants alive and dead in 1966.

RESULTS

Effectiveness of each treatment was expressed in terms of: (a) percent reduction of 1964 crown area of tanoak, and (b) percent kill of sprout clumps present in 1964. Crown area and number of live clumps per acre remaining in 1966 did not show effectiveness of treatment because of the differences in amounts of tanoak on the plots at the time of spraying.

The results from individual treatments in most cases showed extreme variation between blocks *(table 1)*. Because of possible effects from different numbers of plants per plot, we calculated treatment means based on all plants sprayed in three plots. The mean values also show considerable variation for the herbicides and dates within an application method.

Consistency of treatment effect was judged by rating the treatments from 1 to 30 for each block and for all plants sprayed, with 1 as most effective and 30 as least effective *(table 1)*. The treatments with rating of 1 to 12 in each block, and for all plants, are indicated by the underlined entries. This procedure points out the most consistently effective treatments; 16 underlines are possible for any treatment, 8 for crown reduction and 8 for clump kill. Six method-date treatments stand out as being most consistently effective. They also rate high in clump kill and crown reduction:

Treatment:	Sprout clump kill (pct. of clumps)	Crown reduction (pct. of area)
Backpump foliar:		
September	75	88
August	57	69
Mistblower foliar:		
September	56	85
August	53	77
Backpump basal:		
June	61	74
September	42	72

Backpump foliar treatment in July and basal treatment with 2,4,5-T in August also had high ratings.

Average values for the three application methods, including all months and herbicides for each method, show about the same effects from each method.

Table 1.—*Kill of tanoak sprout clumps and reduction of their crown area by three application methods, each at five dates with two herbicides*

Month of application and herbicide	Sprout clump kill[1]					Crown area reduction[2]				
	Block 1	Block 2	Block 3	All plants[3]	Treatment rating[4]	Block 1	Block 2	Block 3	All plants[5]	Treatment rating[4]
	Percent				*No.*	*Percent*				*No.*
MISTBLOWER FOLIAR										
May:2,4,5-T	[6]70	22	14	38	22	79	56	40	53	26
1:1 mix	25	29	67	47	15	41	60	80	66	17
June:2,4,5-T	–	15	50	32	26	–	65	48	56	24
1:1 mix	72	11	33	44	17	83	11	43	49	27
July:2,4,5-T	47	18	32	31	27	83	85	59	71	13
1:1 mix	40	11	67	32	25	82	47	77	67	14
Aug.:2,4,5-T	55	38	75	56	8	88	64	84	78	8
1:1 mix	63	39	47	50	13	90	52	64	75	9
Sept:2,4,5-T	68	42	37	47	14	84	78	64	74	10
1:1 mix	75	50	67	65	5	98	82	95	96	1
BACKPUMP FOLIAR										
May:2,4,5-T	29	42	55	43	19	76	58	68	66	16
1:1 mix	50	27	54	43	18	85	61	69	72	12
June:2,4,5-T	0	9	19	9	29	0	37	27	18	30
1:1 mix	9	0	18	8	30	33	17	51	34	29
July:2,4,5-T	60	6	44	36	23	83	38	81	62	19
1:1 mix	88	22	72	68	3	100	45	83	79	7
Aug.:2,4,5-T	71	44	71	60	6	84	62	79	72	11
1:1 mix	67	59	20	54	11	96	66	44	66	15
Sept.:2,4,5-T	95	67	73	83	1	99	85	90	94	2
1:1 mix	46	54	80	66	4	71	79	90	81	5
BACKPUMP BASAL										
May:2,4,5-T	58	67	40	54	10	84	92	69	79	6
1:1 mix	32	0	30	25	28	54	48	57	54	25
June:2,4,5-T	74	100	53	76	2	88	100	75	84	3
1:1 mix	71	21	70	46	16	88	54	67	64	18
July:2,4,5-T	90	28	20	56	7	98	66	26	59	21
1:1 mix	64	27	25	35	24	54	56	68	58	23
Aug.:2,4,5-T	81	0	75	53	12	92	2	86	44	28
1:1 mix	35	21	69	40	20	68	42	76	58	22
Sept.:2,4,5-T	66	18	57	39	21	97	39	76	60	20
1:1 mix	67	48	55	55	9	93	78	78	83	4

[1]Plants in 1964 that were dead in 1966.
[2]Crown area in 1964 that was dead in 1966.
[3]Based on number of plants in three plots.
[4]Based on all plants; treatments rated from 1 to 30 in order of effectiveness.
[5]Based on total crown area of all plants in three plots.
[6]Underlined entries indicate treatments which rated 1 to 12 in each block and for all plants.

Treatment ratings are intermediate, 15 to 17 for both clump kill and crown reduction. Average clump kill ranged from 47 to 55 percent and average crown area reduction from 64 to 69 percent.

Foliar spraying, either by backpump or mistblower, definitely was more effective in September and August than earlier. The backpump spraying in June produced extremely poor results. The basal spray was effective at all seasons, but appeared best in June with 2,4,5-T.

Comparison of 2,4,5-T with the 1:1 mix of 2,4,5-T and 2,4-D for foliar spraying showed erratic results. For August and September foliar spraying, the 2,4,5-T gave the best results in one case for the mistblower, and in both cases for the backpump. For all months, however, the two herbicides gave about the same average kills for mistblower spraying and for backpump foliar spraying.

For basal spraying the 2,4,5-T was definitely superior to the 1:1 mix for killing the tanoak sprouts early in the season. The mixture produced better results in September.

DISCUSSION

Schubert[2] found that freshly cut tanoak stumps treated with 2,4-D sprouted less when treated in early spring or late fall. Roy[3] tested 2,4-D and 2,4,5-T foliage sprays on tanoak sprouts at four dates. A July treatment resulted in incomplete sprout kill. Complete topkill resulted from an August treatment, but resprouting occurred. October and November treatments resulted in complete topkill with no resprouting. The herbicide 2,4,5-T appeared to give the best control.

Gratkowski[4] found 2,4-D to be as effective as 2,4,5-T when used as a foliage spray for tanoak in Oregon. Diesel emulsions were superior to water carriers. He reported that 2,4,5-T appears to be more effective than 2,4-D in California when only one application is made. But 2,4-D and 2,4,5-T were equally effective if three applications were used. Early spring applications were recommended.

Adams[5] tested a March application of an invert emulsion of brushkiller and a water-oil emulsion of 2,4,5-T. About 9 months later 80 percent topkill of tanoak sprouts were recorded. Both herbicides appeared to be equally effective.

Leonard and Harvey[6] recommended the use of brushkiller at 4 pounds, acid equivalent, in 1 gallon of diesel oil and 98 gallons of water for tanoak control. They suggested spray dates of March and April. One treatment usually retarded tanoak growth enough to release conifers; a second, repeat spray was required for complete control.

In our tests, a single herbicide application gave limited kill of vigorous third-year sprout clumps of tanoak. The most effective treatments killed about half the plants. But these treatments did reduce crown area for 2 years; in 1966 it was down to 15 to 30 percent of the initial crown area in 1964. Control would be considerably greater if compared with untreated sprouts.

We got about the same control by any one of the three methods tested. For the six method-month combinations that were most consistently effective, the variations in results may have been caused more by the operators' diligence and technique rather than by the method itself. The choice of method can be based on feasibility and cost. Our experience indicates that mistblower foliar spraying with the 1:1 mix in August or September is a suitable method.

Repeat applications—preferably in 2 or 3 consecutive years—will be needed for full control of tanoak sprouts. This plan may be feasible on small areas. An alternate approach that appears more practical on most areas is periodic aerial applications to keep tanoak and other broadleaved woody plants in check.

Notes

[1]Roy, Douglass F. *Silvical characteristics of tanoak.* U.S. Forest Serv. Calif. Forest & Range Exp. Sta. Tech. Pap. 22. 21 p., illus. 1957.

[2]Schubert, G. H. *Control of tanoak and madrone stumps.* U.S. Forest Serv. Calif. Forest & Range Exp. Sta. Res. Note 74. 2 p. 1950.

[3]Roy, D. F. *Killing tanoak in northwestern California.* U.S. Forest Serv. Calif. Forest & Range Exp. Sta. Res. Note 106. 9 p., illus. 1956.

[4]Gratkowski, H. J. *Use of herbicides on forest lands in eastern and southwestern Oregon. In,* Herbicides and their use in forestry. Oregon State Univ., Corvallis, Ore. p. 64-83. 1961.

[5]Adams, R. S. *Reforestation studies—1961.* Calif. Div. Forestry, Sacramento, Calif. p. 11-15, illus. 1962.

[6]Leonard, O. A., and Harvey, W. A. *Chemical control of woody plants.* Calif. Agr. Exp. Sta. Bull. 812. 16 p., illus. 1965.

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